



NATIONAL RADIO ASTRONOMY OBSERVATORY

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of: WT Docket No. 98-136

Amendment of Part 27 of the Commission's Rules to Revise Rules for Services in the 2.3 GHz Band
and to Include Licensing of Services In the 47 GHz Band

COMMENTS OF THE NATIONAL RADIO ASTRONOMY OBSERVATORY

The National Radio Astronomy Observatory (NRAO) hereby submits its comments in response to the Commission's July 29, 1998 Notice of Proposed Rulemaking in the NPRM WT Docket No. 98-136. In these Comments, NRAO suggests that the Commission modify proposed Rule 27.53 to provide additional protection for certain Radio Astronomy Stations operating in nearby bands from out-of-band and spurious emissions from High Altitude Platform Stations (HAPS), and aeronautical users of the 47 GHz band.

1. The Importance of the Radio Astronomy Service (RAS) Allocations in the 42.5-43.5 and 48.94-49.04 GHz Bands.

The Radio Astronomy Service (RAS) shares the 42.5-43.5 GHz band on a primary basis with the Fixed, Fixed-satellite (Earth-to-space), and Mobile, except aeronautical mobile, services. The band is used for sensitive observations of the extended continuum emission of radio sources. This band is very important for radio astronomy because of its 1 GHz width and its location in the spectrum. A prominent component of the continuum emission observed in the band is free-free emission from ionized gas around newly born stars, which provides critical information on the physical state of the interstellar medium associated with star-forming regions.

The 42.5-43.5 GHz band also contains several molecular spectral lines. Those listed as of greatest importance to radio astronomy in Recommendation ITU-R RA.314-8 include the SiO transitions which have rest frequencies of 42.821, 43.122, and 43.443 GHz, and the 48.94-49.04 GHz line of carbon monosulphide (CS). All of these have been detected in interstellar molecular clouds, in the atmospheres of evolved stars, and in external galaxies. The first two lines have been observed as strong narrow-band 'maser' emission in the atmospheres of over several hundred evolved stars and massive star-forming regions, and are essential for studies of certain cosmic phenomena such as the birth and death of stars.

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2. Susceptibility of Radio Astronomy to Out-of-Band and Spurious Emissions.

Recommendation ITU-R RA.769-1 gives, in Table 1, the threshold level of detrimental interference in the 42.5-43.5 GHz RAS band as a spectral power flux density (SPFD) of $-227 \text{ dBW}/(\text{m}^2 \cdot \text{Hz})$. The same Recommendation also gives, in Table 2, the threshold level of detrimental interference in the 48.94-49.04 GHz RAS band as a spectral power flux density (SPFD) of $-209 \text{ dBW}/(\text{m}^2 \cdot \text{Hz})$.

Table 4 and footnote 1 of Recommendation ITU-R RA.769-1 give the threshold levels of detrimental interference for very long baseline interferometry (VLBI) observations. The levels are SPFDs of $-173 \text{ dBW}/(\text{m}^2 \cdot \text{Hz})$ for the 42.5-43.5 GHz band and $-172 \text{ dBW}/(\text{m}^2 \cdot \text{Hz})$ for the 48.94-49.04 GHz band. These levels apply to the NRAO VLBA, which is a dedicated VLBI instrument.

3. Example of HAPS unwanted emission levels at a RAS.

Consider a HAPS user downlink transmitter having output power in a 100 MHz channel of 2.2 dBW into a 38 dBi gain antenna. The channel emission would be an EIRP of 40.2 dBW within a 100 MHz bandwidth, which corresponds to 20.2 dBW in 1 MHz bandwidth.

The FCC proposed Rule 27.53(c) states "For the 47.5-48.2 GHz band: The peak power of any emission outside the licensee's authorized bands shall be attenuated below the maximum peak spectral density by at least $43 + 10 \log(p)$ dB or 80 dB, whichever is less." Thus the HAPS emission limit outside the authorized band is -25 dBW within any 1 MHz bandwidth.

As an example of the effect on radio astronomy, consider a HAPS located over Albuquerque, NM, at an altitude of 25 km. The beam could cover the NRAO VLA (Very Large Array) located west of Socorro, NM, which is 148 km distant from the HAPS. The VLA, which operates in both the 43 GHz and the 48 GHz RAS bands, consists of 27 antennas, each of 25-m diameter, arranged in a wye-pattern up to 21 km in radius. Under the assumed HAPS location, every one of the 27 antennas of the VLA would be line-of-sight to the HAPS. Attenuation by 148 km of atmosphere at 47 GHz would be 5.8 dB. The out-of-authorized-band PFD at the VLA would be $-145.2 \text{ dBW}/\text{m}^2$ in a 1 MHz bandwidth, which corresponds to a SPFD of $-205 \text{ dBW}/(\text{m}^2 \cdot \text{Hz})$.

The VLA may be used in several configurations. In the most compact configuration, its sensitivity to interference approaches that of a single dish telescope, especially for baselines connecting antenna pairs which project close to the source of interference. Thus, for the VLA, the threshold levels of detrimental SPFD are $-227 \text{ dBW}/(\text{m}^2 \cdot \text{Hz})$ in the 42.5-43.5 GHz RAS band and $-209 \text{ dBW}/(\text{m}^2 \cdot \text{Hz})$ in the 48.94-49.04 GHz RAS band.

Thus the HAPS considered here, operating at the proposed Rule 27.53 (c) emission limits in the RAS bands, could exceed the Rec. ITU-R RA.769-1 detrimental SPFD at the VLA by 22 dB in the 42.5-43.5 GHz RAS band and by 4 dB in the 48.94-49.04 GHz RAS band.

It is clear from the example discussed above that special consideration is required for protection of the radio astronomy service. The NRAO requests that the FCC regulations regarding emission limits of transmitters operating in the 47.2-48.2 GHz band, and located on HAPS or airborne stations, should include a requirement for coordination with the radio astronomy service. For HAPS, coordination should include all cases in which a radio astronomy station is above the horizon as seen from any HAPS.

NRAO radio telescopes that operate within the 42.5-43.5 GHz and 48.94-49.04 GHz Bands are the following:

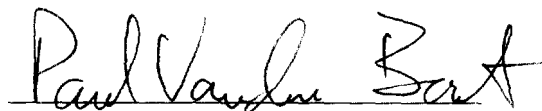
1. The Very Large Array (VLA), near Socorro NM. The VLA consists of 27 antennas of 25-m diameter, arranged in a wye-pattern up to 21 km in radius.
2. The Very Long Baseline Array (VLBA). The VLBA consists of 10 antennas of 25 m diameter, distributed across the continental U.S., Hawaii, and the U.S. Virgin Islands. The locations of the individual antennas are: St. Croix, VI; Hancock, NH; North Liberty, IA; Ft. Davis, TX; Los Alamos, NM; Pie Town, NM; Kitt Peak, AZ; Owens Valley, CA; Brewster, WA; Mauna Kea, HI. As indicated in section 2 above, the threshold values of detrimental interference for VLBI, which apply to VLBA antennas, are considerably higher than those for the VLA. Thus coordination with VLBA antennas should require mitigative action only for relatively close distances between the antenna and the HAPS.
3. The NRAO 12 Meter Telescope at Kitt Peak, AZ.
4. The 100-m Green Bank Telescope at Green Bank, WV, which is still under construction.

In addition, there are several radio telescopes operated by other institutions within the U.S. that make observations in the two bands under consideration.

Respectfully submitted,

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